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Training Manual
on

Cage Culture
of
Marine Finfishes

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Selection of candidate species for cage culture in India

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Introduction

In recent years, cage culture has emerged as one of the most viable method of sea farming. This aquaculture farming system offers the farmer a chance to utilize existing water resources, which is not used for other purposes. At present, situations like increase in consumption of fish, decline in wild stock and poor return from other culture systems paved strong interest for the fish production through cage culture among the fish farmers. Selection of fish species is playing major role in cage culture operation. Therefore, while selecting the species the biological as well as economical criteria should be taken into consideration, which includes available source of fish seed either from wild or hatcheries, seasonal abundance of the fish seeds in wild, acceptance to artificial feeds, consumer acceptance to the fish, economic value of the fish in local and international market, regional preference, compatibility of the species to culture in various system, resistance to disease and stress, ability to breed and produce the seed in confined environments. By considering the above criteria, a variety of commercially important marine fish species are highly found suitable for cage farming. The important candidate species from different parts of the world includes cobia (*Rachycentron canadum*), seabass (*Lates calcarifer*), snappers (*Lutjanus sp.*), pompanos (*Trachinotus sp.*) and groupers (*Epinephelus sp.*), etc. Commercial level seed production technology for majority of these fishes has been developed in many of the South East Asian countries. In India, the seed production of cobia, silver pompano, seabass and orange spotted grouper has been achieved successfully by different fisheries research institutions.

Availability of seed

Availability of adequate quantities of seed stock is an important criteria for species selection in cage culture operation. It is important because, without a certain and ready supply of seed at stocking time, farming becomes unpredictable. Seed is usually fry or fingerling either wild-caught or hatchery produced. In case of wild caught seeds, supply is usually seasonal and unpredictable but they are more robust and hardy as they have already undergone pre-selection by nature. In the case of hatchery produced seeds, supply is more predictable and could be produced on schedule in batch-operation sequence. It is always advisable to select the species for which the hatchery production is in commercial scale, because the farming operations started by rely on wild caught seeds are not withstanding for long period due to scarcity of seeds. Though the seed production technology has been standardized for several species of marine fin fishes around world, in India presently hatchery seed production technology has been well developed only for cobia, pompano, seabass and orange spotted grouper and they form the suitable species for culture. In addition, *Epinephelus* spp, *Lutjanus* spp and *Acanthopagrus* spp are collected from wild and cultured in cages. Although many species are being cultured throughout the world, *Lates calcarifer*, *Epinephelus* spp, *Trachinotus* sp. *Rachycentron* sp. *Lutjanus* spp, *Acanthopagrus* spp. *and Panulirus* spp are found to be more suitable species for cage culture in India with respect to seed availability.

Seasonal abundance of fish seed

Seasonal abundance for different species of fish seed need to be considered for cage culture operation where the practice is depends on the wild seed resources. This information is essential to plan the cage culture operation in well advance. In India, recently concentrated effort has been put to collect the

information regarding the availability of seed from wild by CMFRI and other fisheries colleges across the Indian coast under the All India Network Project on Mariculture. This will certainly help to get the clear picture on the seasonal availability of fish seeds in different parts. In Andhra Pradesh availability of wild seabass fish seed observed in the month of April to December.

Stocking density

Stocking density depends on the carrying capacity of the cages and the feeding habits of the cultured species. Optimal stocking density varies with species and size of fish. Uniform sized fish should be stocked in the cage to obtain growth of the fishes, which will help to avoid cannibalism among the stocked fishes. Stocking at lower densities will help to get bigger in shorter time than the stocking fishes at higher densities. However, stocking fish at densities lower than recommended numbers may result in aggressive behaviour. The best time for stocking is when the water temperature is cool. This will reduce the handling stress, stress related disease and mortality.

Fast growth and time to reach marketable size

Most of the aquaculture production system in confined environment is constrained largely by the growth efficiency of the species cultured. Thus, the growth rate of the fish is an important criteria for the selection of a particular species. The fish species with medium to fast growth rate is considered as suitable for the culture, essentially the fish with fast growth rate will help to get maximum economic benefit to the farmers. In general, the selected fish should reach at least the table size within 6-8 months of culture period, eg: sea bass, grouper, snapper, cobia etc. The optimum market size for the fish is around 500-800 g. However, fishes like cobia and seabass grows more than 1 kg/year after stocking in grow out

system. In addition, factors like feeding, water quality and stocking density, etc plays important role in enhancing the growth rate of the fish in a culture system and manipulating these parameters may have positive impact on the growth.

Acceptance to artificial feed / external feed

Acceptance to artificial feed by a fish plays major role in selecting the species for cage culture activities since there are no significant sources of food except for small fish which stray in and out of the net. So, the selected fish must be able to accept external source of food especially if the species is carnivorous. The external source of feed may be of natural source, usually chopped trash fish or sometimes artificial feed (floating/sinking/slow sinking pellet). The response of the fish towards feeding differs according to the species, so the feeding should be depends on the feeding behaviour of the fish. It is observed very well that the fishes like grouper, sea bass, snapper and pompanos respond very well to the artificial feeds that are given in the cage. Therefore, these kinds of fishes are most suitable for cage culture activities since they utilize the feed efficiently and avoid feed wastage.

Consumer acceptance and price of the species in the market

It is very important character to select the for any culture operation, the fish should get good consumer acceptance with high market value to cope up with relatively high cost of production in net cage farming and also to get high profit to the farmer/cultivator. Species having high market value in live fish trade would be more appropriate for cage culture, e.g grouper and other reef fishes. The biggest advantage of cages is that the fish can be easily harvested in live condition and marketed as per market demand. Some of the important potential high value

finfishes and shellfishes available in India are: groupers, snappers, seabreams, cobia, sea bass and lobsters.

Regional preference of the species

It is understood very well from the long observation is that some of the fish species are popular in specific region of the country because of their availability, taste. Thus, they are mostly preferred in that region and fetching high price in the market. The selected species for cage culture should have either international acceptance or regional preference. In India, fishes like, Indian sand whiting *(Sillago sihama*), pearl spot (*Etroplus surentensis*) and hilsa (*Tenualosa ilisha*) are considered as delicacy and poplar fish in states like Karnataka, Kerala and west Bengal, respectively. These fishes can be given preference along with the fishes of international importance for the culture in cages.

Compatibility of the species

Integrated multi-trophic aquaculture (IMTA) is an ecosystems approach in mariculture that has been proven to solve sea pollution problems associated with fish culture mainly in temperate waters. In this system, the organisms occupying different tropic level maintained in the same culture system and it is different from poly culture. This type of culture mainly practised in many of the countries for the farming of different species, where the wastes of one species recycled as feed for another species. While selecting species for this kind of culture, the main target cultured organisms such carnivorous fish is nourished by feed such as artificial pellets or trash fishes. The co-cultured organism that is the extractive organism is extracts their nourishment from environment i.e. the waste of fed fish (cultured fish). The two economically important cultured groups that fall into this category are bivalves (oysters and mussels) and seaweed. Combinations of co-

cultured species will have to be carefully selected by understanding the compatibility the organisms. In India, green mussel has been cultured with carnivorous fishes like seabass and cobia and this system of culture has shown as successful method of culture.

Resistance to stress and disease

Species selected should be hardy and tolerant to the stress conditions like confined environment, crowded conditions and rigorous handling during net changes in cages. Stocking density in net cages is comparatively higher than the pond culture. Therefore, in net cages the fishes are subjected to greater physical contact and stress during feeding as there is often a rush for the food by the entire fish population in the net cage. If the fishes in the cage are not able to manage to the stressful condition in the cage, then it may leads to secondary bacterial infection, eventually stock in the cage may collapse. Thus, the selected species should with stand the above condition. In India, fish species such as seabass, cobia, groupers, and snappers have found to be potential species for culture and they with stand to the stressful condition prevalent in cages.

Ability to reproduce and spawn in captivity

Availability of sufficient number of fish seed is the major factor for the sustainable production of fish through cage culture technology. A fish species for which the seed production and nursery rearing technology has been standardised in confined environment may be suitable species for the culture, since continuous seed may be available for the uninterrupted culture. Breeding, seed production and nursery rearing techniques in confined system has been developed for more than 20 number of marine fin fishes species in different countries across the world. In India, seed production techniques for fishes like cobia, seabass, silver

pompano and orange spotted grouper has been standardised and they may be suitable species for culture in cages.

Candidate species for cage culture in Asian countries

Brackish water and marine farming is dominated by few species. Marine fish farming is entirely from cage farming and the leading fish species in cage culture are follows:

Species prescription	Advantages	Constraints
Chanos chanos (milkfish) • Major producer: Philippines, Indonesia, Taiwan province of China. • Production: 872 184 tonnes in 2012	• Omnivorous/herbivorous. • Fast growth in both pond and sea cages (commercial size in 6 months) • Fry available from the wild • Tolerates high fluctuations in salinity. • Suitable for polyculture.	• Hatchery successes are yet to be standardized in most of the countries and mostly rely on wild fry. • Moderate-to low-value fish. • Only suitable for domestic markets
Lates calcarifer (barramundi) • Major producer: Indonesia, Malaysia and Taiwan Province of China. • Production: 185 073 tonnes in 2012	• Hatchery seed production standardized. • Fast growth (plate size in 4 months, 1 kg in 8 months). • Suitable for both pond and cage culture. • Very high tolerance of salinity and water variations (freshwater to marine culture). • Ideal species for culture high demand for fresh fish in local consumption.	• High protein diet is required. • High cannibalism.
Rachycentron canadum (cobia) • Major producer: China and Taiwan province of China. • Production: 41 399 tonnes (2012)	• Routinely produced in most hatcheries. • Very fast growth (6–7 kg in year). • Suitable for high-density cage culture and easy to culture and manage.	• High protein needs but quite good FCR (<2). • Needs relatively large production units, less than 30°C & high-quality water. • Sensitive to diseases,

	• Suitable for mass production of white fillets (fresh/frozen). • The survival rate in grow out is high, and it is not difficult to obtain 90% average survival.	especially in lower quality water. • Not very high value on fresh domestic market or whole fish export market.
Jacks *Seriola quinqueradiat, S. rivoliana & S. lalandi* (amberjack) • Major producer: Republic of Korea. • Production -177 909 tonnes (2012) Japan – major producer (160 215 tonnes)	• Fast growth (2 kg in 12 months). • Suitable for intensive hatchery production. • High retail prices. • Suits fresh fish market and sashimi market. • Suitable for both export and local market.	• Brood stock can be hard to find & not well known in most areas. • High protein needs, mostly very high lipid needs (20% or more) and quite high FCR (>2). • Sensitive to parasites. • Subtropical species that might only be for culture in areas.
Siganus spp (rabbit fish)	• Omnivorous/herbivorous. • Medium growth (commercial plate size in 9–12 months). • Suitable for cage culture and tolerant of high stocking densities. • Some species can tolerate variations in water quality (*S. lineatus*). • High prices in some areas. • Suitable for capture based aquaculture (CBA).	• Hatchery production not yet fully developed for all species. • It has venomous spines, which might cause handling problems during culture and harvest. • Value is moderate in some areas. • Known to graze on net cages and thus damage them.
Snappers: (*Lutjanus argentimaculatus*) (mangrove jack) • Major producer: Malaysia , Cambodia, Brunei, Darussalam, Hong Kong SAR, Singapore and the	• Valuable if fish is in red coloration. • Suitable for cage culture. • Tolerant of low salinity. • Tolerant of water-quality variations. • Native to most places with estuarine systems.	• Cultured mangrove jacks are usually grey in colour (lower value). • High protein needs. • Slow growth. • Market value is medium.

Philippines. • Production: 7 283 tonnes (2012)		
Lutjanus sebae (red emperor)	• High-value fish for both fresh export market and local markets. • Suitable for cage culture.	• Routine hatchery production yet to be demonstrated, but has been demonstrated for some species from same genus • High protein needs.
Epinephelus spp (groupers) • Major Producer: China, Taiwan, Indonesia, Malaysia, Thailand, and Philippines. • Production -118039 tonnes (2012)	• Hatchery techniques have been standardized for few species of grouper. • Suitable for both cage and pond culture. • Can be a by-product for shrimp farms. • High prices in live fish market. • High prices on most domestic and international market. • Medium size fish, which makes it easier to handle than other larger species. • Relatively fast growth (plate size in 9-12 months).	• Need high protein diets. • High cannibalism during late larval rearing and early nursery phases. • High competition for export markets with Southeast Asia.
Asian or silver Pompano (*Trachinotus blochii*) •Production - 110,000 tonnes (2011)	Optimum growth, suitable for intensive hatchery production, high retail price and easily acclimatised to different range of salinity and well acceptable for artificial feeds.	• Need high protein diets.
Mugil spp (mullet) • Major Producer: Egypt, Republic of Korea, Italy, Taiwan Province of China and Israel. • Production-13 890 tonnes in 2012	• Fry available from the wild. • Good candidate for food security in densely populated areas, at family scale if juveniles available. • Tolerant of water quality. • Suitable for both pond and cage farming.	• No export value. • Low value in most fresh fish markets. • Hatchery production yet to be standardized in several places.

Important cultivable species

Lutjanus argentimaculatus: Mangrove red snapper

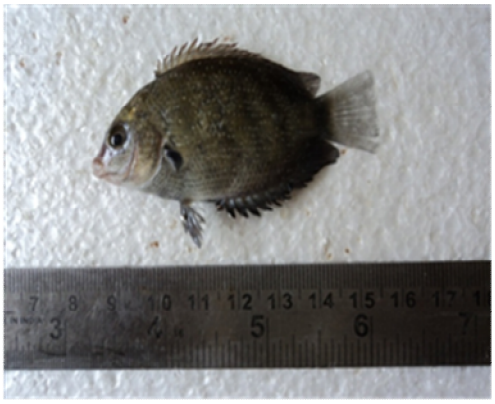
Lutjanus johnii : Golden snapper

Lates calcarifer - Seabass

Chanos chanos - Milk fish

Siganus javus - Streaked spinefoot

Trachinotus mookalee – Indian pompano



Etroplus suratensis : Pearl spot

Epinephelus coioides : Orange spotted grouper

Rachycentron canadum : Cobia

Sillago sihama : Indian sand whiting

Trachinotus blochi : Silver pompano

Mugil cephalus: Grey mullet

Other species

Apart from mentioned species, a wide range of other species are cultured, including threadfins, croakers, drums, gobies, scorpion fishes and others. Many of these species are grown at least on an occasional basis in marine cages. Therefore, above mentioned characters should be critically analysed and give most importance while selecting species for cage culture activities. Some of these characters may have more importance in different places and accordingly those characters need to be given more priority in specific locations to reap the more economic benefit and make the culture system sustainable.

Suggested readings:

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